Materials Degradation During the Stressed Oxidation of CMCs

Completed Technology Project (2017 - 2021)

Project Introduction

The objective of the proposed research is to quantitatively characterize and understand the effect of oxidation of composite constituents on the initiation and accumulation of damage (including crack opening displacements and densities), as a result of factors including the applied stress, oxidation degree, and surrounding composite architecture. My research will utilize novel experimental methodologies including SEM-DIC, Acoustic Emission, and Electrical Resistance measurements to provide guidelines on how to mitigate premature component failure through the design of damage-tolerant architectures. I will first perform a suite of room-temperature monotonic and dwell fatigue-cracking studies, and use the resulting data to guide elevated temperature testing. I will combine automated SEM, chemically functionalized self-assemblies of nanoparticles on CMC specimen surfaces, and spatially and temporally distortion-corrected digital image correlation, to enable the acquisition of large, information-rich data sets with extremely high resolution and accuracy. Adopting this new approach towards the characterization of CMCs will allow me to integrate statistical and unsupervised learning methods with materials science in order to examine stochastic behaviors, such as the effect of subsurface composite architecture, on damage accumulation under various oxidative and thermo-mechanical loads.

Anticipated Benefits

The objective of the proposed research is to quantitatively characterize and understand the effect of oxidation of composite constituents on the initiation and accumulation of damage (including crack opening displacements and densities), as a result of factors including the applied stress, oxidation degree, and surrounding composite architecture. Adopting this new approach towards the characterization of CMCs will allow me to integrate statistical and unsupervised learning methods with materials science in order to examine stochastic behaviors, such as the effect of subsurface composite architecture, on damage accumulation under various oxidative and thermo-mechanical loads.

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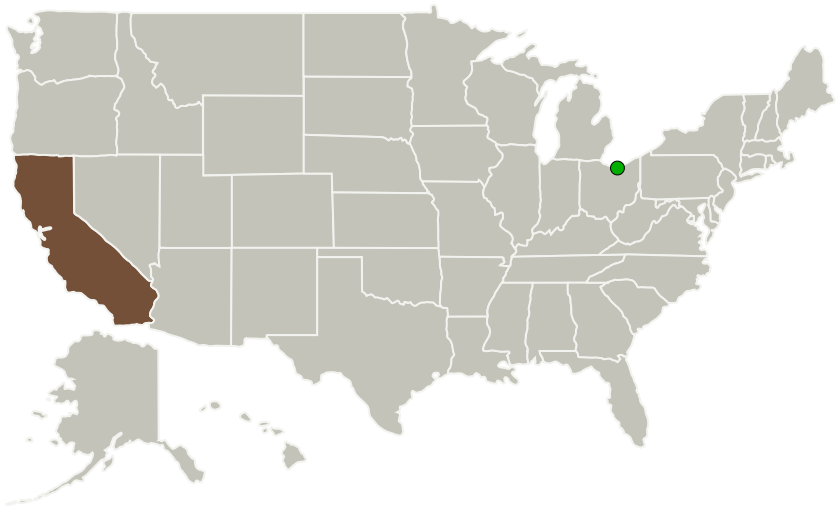
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of California-Santa Barbara(UCSB)	Lead Organization	Academia Asian American Native American Pacific Islander (AANAPISI), Hispanic Serving Institutions (HSI)	Santa Barbara, California
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of California-Santa Barbara (UCSB)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Samantha Daly

Co-Investigator:

Bhavana Swaminathan

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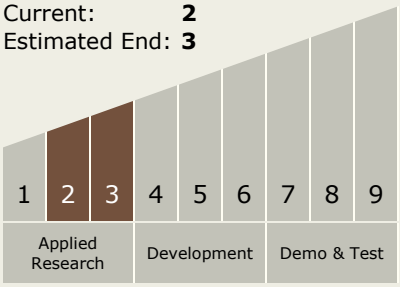
Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.4 Materials for Extreme Environments

Target Destination

Foundational Knowledge